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INTRODUCTION

While population pressures increase in the traditionally settled areas of many Latin American countries, a number of these nations have within their boundaries vast, virtually unpopulated regions. The advance of settlers into these unpeopled tracts has, at times, become nearly legendary, e.g., the swashbuckling bandeirantes of Brazil. This paper discusses some of the characteristics of various land settlement strategies and relevant considerations for evaluating the economic aspects of land settlement projects.

I. PURE AND MIXED STRATEGIES IN COLONIZATION SCHEMES

Let us identify as pure strategies the activity lying at each end of a spectrum; one is the large planned and directed (usually by the government) colonization project, while the other is the internal migration of persons into agricultural activities in relatively unsettled areas with little or no assistance beyond their individual resources.* Is either variety the most effective colonization policy to be followed, or is it possible that programs consisting of a mixture of government direction and reliance on the initiative and resources of actual and potential colonists offer the greatest promise of success?

The objectives of a settlement scheme may be one or several of the following:

1. Redistribute agricultural population from areas of high density.
2. Increase agricultural output and/or food availability.

*These are not merely ideal types; examples will appear later.

3. Improve levels of living of the farming population.
4. Related to the above, reduce economic, social, or political discontent in some areas.
5. Strengthen territorial claims in frontier areas.
6. Reduce migration to urban areas.
7. Contribute to an agrarian reform program.

There may be others also. Note that a combination of the first two or three objectives (among the most popular or most commonly cited) may contain some mutual inconsistencies. For example, agricultural output may not increase unless the colonists coming out of the overly populated area are of above-average ability and are given and are responsive to above-average opportunities; a poverty criterion for inclusion in a colony might eliminate such people. On the other hand, why should a successful peasant farmer want to move to a colonization scheme?

Suffice it to say that the goals of a scheme will in part determine its design. More important, however, is the question of resource availability. This will largely determine not only the design of the program but also the extent to which various possible program objectives might be fulfilled, hence requiring a possible trade-off between objectives or their degrees of satisfaction.

Suppose, however, that we are able to develop a set of generally acceptable objectives, such as the first two or three mentioned above, and including some dictum with respect to minimizing resource cost. Are there any examples of the pure strategies in operation? The model project of the Venezuelan government at Turén approaches the ideal pure strategy.* It appears, however, to run up against the resource constraint. Development costs were some \$1,500 per hectare; installing a family on a ten-hectare plot would run over \$15,000, not including any working capital which might have to be provided.** Perhaps output results have justified this expense; there are indications that

* Santo Domingo in Ecuador may be another one, as also may be Tornevista, a private project in Peru.

** R. Penn and J. Schuster, "La reforma agraria de Venezuela," Revista Interamericana de Ciencias Sociales, Vol. 2, No. 1, 1963, p. 29.

they have not, but in any case the truth should be ascertained. And even if the results were positive, might greater benefits have been obtained from less-sophisticated schemes which would have included more people at the same (or less) cost?

At the opposite extreme of very little or no government involvement in colonization, we observe examples on the eastern llanos of Colombia,* the Peruvian montaña, and the Bolivian yungas and llanos (Caranavi-Alto Beni, Chapare, and Cascal). Often the movement followed (or at times even preceded) the construction of roads into new areas. Usually, follow-up support by the government has been absent; occasionally even the road construction was for other than colonization purposes and typically was not preceded by examination of the agricultural potential of the area in question. This practice has had the occasionally unfortunate results of indiscriminate utilization and exhaustion of agricultural and forest resources, and establishment of subsistence agriculture in tropical environments where the absence of minimal health facilities may prove debilitating or fatal.

If the pure strategies have shown little promise in the past, what about a mixture of some of the elements found in each? What if, at a Turén-type project, a large number of colonists settled in the same area, acting on more or less their own initiative but owing their presence to the existence of the scheme? In this case the resources devoted to the project itself would have an impact beyond the scheme's boundaries.** Any cost-benefit discussion should include those attracted by but living outside the colony and the area they cultivated and their output. This has been referred to as the "oil stain" concept.***

* R. Crist and E. Guhl, "Pioneer Settlement in Eastern Colombia," Smithsonian Report for 1956, pp. 391-414.

** Of course, it is not necessary that the government entirely ignore this spontaneous reaction. Minimal assistance, e.g., extension or supervised credit, may give good results.

*** As pointed out by Dr. F. T. Moore of The RAND Corporation in a conversation with the author.

Another possibility is for the government to develop a colonist training center where each family participating in a scheme would spend several months. Men would be trained in the crops and agricultural practices appropriate to the region while women could receive training in homemaking and household industries.* Upon satisfactory completion of the course, they may be moved out to areas where plots are demarcated on uncleared and unimproved land and set about clearing cropland and building homes. Some amount of agricultural extension services, credit, and habilitación (seeds, tools, initial provisions) may also be provided.

A third possibility would be similar to the preceding strategy, with the omission of the training center. Assurance of some minimal level of colonist ability could be attempted by some selection criteria regarding previous occupation, age, health, family size, resource contribution, etc. Resources released by foregoing the training center could then be applied to increasing the scope or coverage of the colonization scheme or (probably less desirable in some cases) increasing the social services or participation of the government in the project.

There appears to have been no purposeful activity in developing colonist training centers. Perhaps this owes in part to the lack of well-designed colonization projects. There is the possibility, however, of unintentional activity of this type. This occurs when colonists leave a government-directed activity but remain in agricultural pursuits in the area or move on to a new colony or another unsettled area. Experience or knowledge acquired in the initial colonization scheme may be of significance in future agricultural success. This possibility has not been investigated. Usually, colonist retention or drop-out rates are merely cited without any discussion of their real significance or the destination of the departing colonists.

*Colonies are often in areas very different from the colonists' places of origin, meaning that crops and diets are also different from what they are accustomed to. Also, their level of agricultural ability, or knowledge and application of proper techniques, may be low.

The third approach we might call a "semidirected" one.* I think some of the Corporación Boliviana de Fomento colonies in Bolivia demonstrate how these might be poorly organized, e.g., providing schools and free medicine but little technical direction, no colonist selection criteria, and no credit availability. The sparse data available on the Cuatro Ojitos and Huaytú, and especially the Aroma, colonies indicate they have not been complete failures -- perhaps in spite of their organization and operation.

While the realization may not yet be general, it has been pointed out by several that the types of activities we have here labelled pure strategies do not appear to be the most desirable or successful.** Yet there has been no purposeful pursuit or investigation of the possibilities offered by the alternative mixed strategies described here. Before we make anything approaching firm judgments or recommendations, however, much more research is required.

*In Ecuador the preferred expression is "colonización orientada." According to Juan F. Casals ("La Estructura Agraria del Ecuador," Revista Interamericana de Ciencias Sociales, Vol. 2, No. 1, 1963, p. 56), colonización orientada is the case in which the state limits its actions to encouraging and supervising the settlement and offering it certain assistance in its development.

**Penn and Schuster, op. cit., pp. 29-39; Crist and Guhl, op. cit. That it is not generally realized or accepted is shown by a CBF plan for the Rio Beni Valley in which colonists (apparently poorly or not at all selected by proper criteria) are established on cleared, planted plots with homes already built, with various social services; C. Ferragut, Principal Characteristics of the Agricultural Colonies of Bolivia and Suggestions for a Colonization Policy, FAO, La Paz, 1961.

II. PROBLEMS AND APPROACHES IN EVALUATION OF SETTLEMENT AND COLONIZATION ACTIVITIES

This is an attempt to organize a procedure for investigating and analyzing land settlement (colonization) activities in Latin America. It is motivated by study and reflection on some of the factors to be considered in settlement evaluation and by the current absence of a guide to analysis and evaluation or even an organized discussion of relevant factors.*

The framework must be sufficiently flexible to allow investigation of various types of settlement activities, whether they be organized and directed in relatively minute detail by a public or private entity or whether they consist of spontaneous, pioneer settlement. Evaluation will be done at several "levels." First, the formulation or design of the activity will be looked into. We want to know something about the sequence of decisions which determined this particular system as the one to be adopted. Second, the actual implementation and operation of the activity will be examined. Third, costs and payoffs of the activity will be evaluated at both the aggregative (project) level and the individual or farm level.**

PROJECT FORMULATION

Important factors at this level are the organizations and persons involved in designing a project, the physical nature of the area in which the activity will be located, the institutional structure of agriculture, and sources of financing settlement activities.

*Much has been done along the lines of evaluating irrigation or land reclamation projects, but our subject is broader than these types of activities. One of the most suggestive of these, however, is a document of the IBRD prepared by Herman G. Van der Tak, The Evaluation of Agricultural Projects: A Study of Some Economic and Financial Aspects, Report No. EC-128, May 7, 1964.

**We will not examine problems of project financing, which are very interesting but beyond the immediate focus of our study.

The technical competency, experience, and training of the persons who design a project will also be important. The resulting system to a large degree will reflect these factors and their philosophy of settlement. Complications may arise from high rates of personnel turnover, frequent shifts of responsibility between individuals or agencies, interagency jealousies, etc.

The nature of the area to be settled will influence project composition.* Some areas can be summarily rejected as unsuitable for settlement because of climate, terrain, or quality of soil. The remaining areas will probably differ sharply in irrigation requirements, soil nutrition requirements, optimal cropping patterns, distance to markets, etc. Resource surveys of potential areas are generally desirable.

The institutional structure in the agriculture sector will play a role in determining the tenure arrangements within a system, the quality or level of performance of participants (colonists), the need for investment in a cadaster, credit arrangements, and the markets for agricultural inputs and products.

Finally, the availability of financing or technical assistance at the international level may contribute to a bias in project design. First, agencies that lend money tend to require certain controls on the types of disbursements to be made and their accounting. Second, the prospect of having to repay loans encourages recipients to become closely involved in the programming and utilization of funds and participation in or recoupment of payoffs. Thus, external assistance to settlement activities has tended to be for rather restricted uses and usually in projects under the relatively close control of public agencies.

*The organization of this discussion does not imply the chronology of events -- e.g., projects designed before areas are chosen.

PROJECT IMPLEMENTATION AND OPERATION

To the extent that public agencies participate in the system, the remarks made above with respect to training, experience, competence and philosophy are important factors in determining whether an activity will be implemented and operated successfully or unsuccessfully.

The success or failure of a system largely hinges on the settlers. In the spontaneous or pioneer forms of settlement, there operates what is ordinarily called a "natural" system of selection: It is commonly believed that those who enter or stay in an area of their own free will are ipso facto the "best" or "most successful" colonists. An alternative system, such as an irrigation settlement, may have elaborate criteria with respect to age, health, family size, education, former residence, former occupation, net worth, politics, nationality, race, religion, etc. Applicants may be classified according to these and a quota allowed for each class. Different settlement systems should probably include differing sets of settler criteria. Observation will demonstrate that criteria have been differently applied.

When a colonist arrives at a settlement site or area, certain resources will be available to him for installation. The pioneer's resources will largely be those he has brought with him; they may be physical or financial, plus his experience or capacity. There may also be an established road and transportation system (of various degrees of sophistication), cadastral or land titlement provisions, marketing and distribution arrangements, and other infrastructural elements. In sponsored or directed settlement systems the colonist may encounter housing, cleared (and perhaps planted) fields, initial subsistence credits, considerable technical assistance or direction, established community centers, etc. The resource package is ordinarily of considerably higher value than in the first case. Problems arise as to the absolute size of the resource package, the relative size of its components, and timing as to their availability, e.g., completion of farm-to-market roads a year after settler installation while first marketable crops mature in only six months.

The same questions are relevant to the on-going assistance after

installation. In pioneer areas this package may be small or minimal. In "sophisticated" projects the package may be large and consist of considerable technical assistance or direction, the quality of which is crucial. The same is true of its timing, e.g., custom plowing, credit, etc.

ECONOMIC EVALUATION OF SETTLEMENT SYSTEMS

Systems will be evaluated at both the project or activity level and the farm level. The former will be divided into two stages, project construction and project operation.

Pioneer settlement does not lend itself easily to this type of analysis. Project construction usually reduces to the construction of penetration roads into a region, some resource surveys, perhaps a cadaster, an army, or police post which includes a few social facilities and nothing more.* It is not even clear whether these elements should be legitimately (conceptually) costed solely against the pay-offs of settlement, rather than attributed to general governmental activities. On the other hand, these activities require resources which in some cases do have opportunity costs; for that reason, at least some portion of the cost should be relevant when a system is evaluated. The rates at which inputs should be valued will be discussed shortly.

In the case of public-sponsored or directed activities it may be easier to identify relevant elements. Once more there may be the dilemma of which activities are properly chargeable to the settlement and the rate at which they should be valued.

* Dispersion of authority among various uncoordinated bodies may complicate the matter. Some of the infrastructural activity may have been undertaken with little regard for an area's settlement potential.

(1) The land input in settlement activities is usually difficult to value. The usually restricted market for land in many LDC's (Less Developed Countries) and the social prestige often attached to land ownership (but not necessarily land exploitation) operate to make market prices unreliable guides to opportunity costs. The very low prices on virgin lands in unsettled areas of LDC's which experience unfavorable man/land ratios in the agricultural sector may be as poor a guide as the much higher prices of the same land once penetration roads expose the virgin lands to settlement and exploitation.

In some arid areas there may be lands that have a very high productive potential but are currently worthless owing to the lack of irrigation water. A contiguous plot which is assured of so many acre-feet of water sufficient for corn production may carry one value, while another plot with a water supply sufficient for paddy rice may carry an appreciably higher value. The unirrigated land, however, ordinarily should bear a very low or zero opportunity cost.

(2) The labor requirements of a settlement system in the process of construction or development are of two types, skilled and unskilled. Among the first we may include those who designed the project on paper as well as the engineers, scientists, etc., actually involved in studying the site and supervising the development of the infrastructure. Capable persons of this kind are scarce to begin with in LDC's, and may be discouraged by the very low salaries offered. The salaries paid are probably poor guides to the opportunity costs of devoting these resources to the activity; they should probably be increased (perhaps even doubled) for project evaluation purposes.

When it comes to unskilled labor, the reverse is probably true. For a variety of reasons, wages for manual workers may be higher on a project than in the surrounding area. We do not want to become involved in the argument over the negative or zero marginal productivity of unskilled or agricultural labor in LDC's. Let us merely suggest that wages for part-time farm labor or unskilled urban construction workers in the area may provide some guidelines for ascertaining the opportunity cost of unskilled labor involved in developing settlement activities.

Some settlement systems require an appreciable amount of labor from the colonist himself during the installation phase, especially in pioneer or spontaneous settlements. This may be for land-clearing, road-building, irrigation ditch-digging, home or community center construction, etc. Occasionally, it is suggested that this activity has no opportunity cost and therefore should not be considered in project evaluation. This is not necessarily so. In most cases, the settler was probably at least a subsistence farmer before he came to the project; in those systems with high-level criteria for settler selection, he may have been a relatively successful peasant farmer. His involvement in infrastructural activities does have an opportunity cost which should be included in project evaluation.

In summary, it would appear that skilled-labor inputs tend to be undervalued while unskilled labor inputs tend to be overvalued; it is therefore possible that these two countertendencies may cancel out. This is only conjectural, however, and in any case the result may be to bias systems towards an overutilization of scarce skilled factors and an underutilization of unskilled factors. (Might this show up in a tendency to favor irrigation or closely directed systems over pioneer settlements?)

(3) Other input requirements for settlement activities may be financed from both national budgets and external assistance. Several valuation problems are involved. One derives from the valuation of locally produced material inputs devoted to the project gestation or construction period. To what extent do the market prices of national cement, steel, machinery, power, etc., measure the opportunity costs of devoting them to the activity in question? Are they subsidized (i.e., underpriced) or protected (i.e., overpriced)? Is there substantial excess capacity or overutilization in the relevant industries?

With respect to imported items, what is the country's balance-of-payments and foreign-exchange position? Is the currency overvalued? Is there a great deal of demand from alternative development activities in the private or public sectors which remain unsatisfied, while the government can devote dollar-amounts to material

imports for the project in question? In such instances it may be that the opportunity costs of the imported materials devoted to the activity may be higher (or lower) than their dollar values.

(4) The sum of these investments represents a capital cost which should be recouped over a period of time. Perhaps a suitable time horizon is in the 25-50 year range. Once this is determined, there are two avenues of approach. First, one may estimate a discount rate believed to approximate the local opportunity cost of capital, and use this to obtain the present worth of all costs and returns of the project. If the result is positive, it is a good project; it may not be the best, however, since an alternative system may have a larger present worth.* The alternative approach is to find that rate of discount (internal rate of return) which sets the present worth of the project at zero and compare this to the internal rate of return of other activities.**

As investment costs are spread over a period of time (as many as five or ten years in some cases), they should not go free of time-considerations during this running-in period.*** (Unfortunately, these costs are occasionally not discounted at all or are discounted only at a financial rate of interest, e.g., 6 percent, with typically no consideration as to whether this rate adequately reflects the opportunity cost of capital.

* Current and future budget restraints will to some extent limit the number of projects among which choice can be made.

** Budget restraints again apply. This second approach is inferior because it does not guarantee choosing the activity with the maximum present worth.

*** On the day project development commences, the present worth calculation would be

$$PW = - \sum_{i=1}^n \frac{C_i}{(1+r)^i} + \sum_{j=n+1}^m \frac{R_j}{(1+r)^j}$$

The first term represents the construction cost for the construction period (years 1 to n) and the second term represents the present worth of annual net benefits (returns - costs of operation (including farm operating costs)) which start in year n+1. The internal rate of return would be that r which gives a PW of 0. Perhaps several calculations should be made to take into consideration alternative cost and return possibilities in view of the uncertainty in which any single set of figures may be held. In the above equation it is assumed settlers are not installed and/or producing until year n+1.

Project Formulation

The observations made above with respect to the valuation of labor inputs are also applicable to project formulation. Some systems include a good deal of technical and social assistance or direction, requiring trained agronomists, extensionists, and home economists -- people typically in short supply in the LDC's. Also, the labor inputs of skilled farm settlers may have a high opportunity cost.

Other inputs may also have high opportunity costs. In arid regions, irrigation water devoted to required (by fiat) foodstuff crops on a project might be more productively diverted to cotton or sugar cane crops for export. Alternatively, land and water may (unintentionally) be encouraged to shift to crops for export rather than domestic consumption owing to a government policy fixing foodstuff prices at an unreasonably low level. Similarly, nationally produced fertilizer, seeds, or implements may be over- or underpriced (with respect to opportunity costs) according to whether they are protected or subsidized. Imported items may not be priced to reflect the opportunity cost of devoting foreign exchange to their purchase. Interest rates on credit extended by government agencies may reflect neither the opportunity costs nor the risks of channelling loans towards the project.

Project Payoffs

The most generally accepted measure of the returns or payoffs of settlement projects is the increase in the value of agricultural production which may be attributed to them.* There are three relevant variables, then: the areas to be cultivated, the yield per unit of area, and the price per unit of output.** None of the factors can be specified with complete certainty.

* We do not expect to encounter situations where there would be a reduction in flood damage, an improvement in recreational services, prettier scenery, etc. If the case is otherwise, these payoffs may also be included in the evaluation.

** Assumptions must be made as to future demand conditions and supplies from alternative sources.

Newly settled large tropical regions may have only relatively narrow flood plains with small slope and productive soil; however, nutrients may leach out of the soil after several rains, once the forest cover is removed. There may be frequent floods, high rates of erosion, etc. In arid areas new irrigation projects may unfavorably alter water tables, change downstream water-availability, introduce drainage and salinity problems, and in other ways have a less favorable impact on the increased area under cultivation than was anticipated.

The crops cultivated on settlement farms may not come up to expectations. Conditions may vary widely between experiment station situations and the actual farms. Farmer competence may be less than was anticipated or projected. Optimal combinations of seeds, water, fertilizer, weeding, etc., may vary over the settlement area. Strains may degenerate. There may have been insufficient experimentation. Farmers may refuse to follow technical advice. For any number of reasons, crop-yields may fall short of anticipations.

What are the prices at which output is valued? If they are market prices (i.e., farm-gate prices) does this reflect a government policy of depressing foodstuff prices, subsidizing or taxing exports, etc.? Could real returns be more properly measured by (a) estimating the cost of doing without the increased production, or (b) the costs of alternative means of obtaining the products (e.g., importation of foodstuffs)? Is foreign exchange so scarce that export crops should be assigned a higher value than what they actually earn on the world market? (Or do export crops enter a foreign market under a preference system or quota arrangement which gives them an unnaturally high return?)

Finally, intangible factors such as export diversification, import substitution, the relief of political or social pressures in rural areas, or lowering the rate of migration into the cities may play a role in evaluating projects.*

*These factors need not be entirely intangible. Monetary estimates may be made of the losses avoided by shifting to crops not glutting the market now or in the near future, the foreign exchange

Now we turn from our overview to a discussion of relevant factors from the point of view of the settler, on whom in the end the success or failure of a system may well depend. He must have available the proper package of resources and incentives to use them well.

The area he cultivates or is expected to cultivate must be related to the amount of labor (family and hired) that is locally available, the times at which it is available relative to the times it is required, and its cost. It is senseless to allow a man title to fifty hectares of virgin land in an isolated area when he and his family can clear and cultivate only two or three hectares a year. Neither should a family be installed on a two-hectare irrigated plot which can profitably absorb only two-thirds of the family's available man-days, in the absence of alternative employment opportunities in the area.

The inputs of seeds, fertilizers, water, custom plowing, etc., should be made available in the proper quantities and at the proper times to encourage the settler to make every effort to improve his net income position. The same is true of the quantity, quality, and timing of the technical direction and assistance, and credit for production and investment purposes.

The prices at which inputs are made available also play an important role. If additional land is available at a very low cost, land-hunger may be the result. Unless irrigation water is correctly priced, the settler may use too little, reducing crop yields, or too much, wasting a scarce factor in arid regions and possibly encountering problems of drainage or salinity.

Prices of inputs and outputs must be related to production techniques in such a way as to encourage the settler to utilize these in combinations which not only maximize his net income but also reflect the social priorities (real costs and returns) which were relevant

saved by producing a crop locally rather than importing it, the production lost and damage incurred from rural violence, the cost of construction and infrastructural services when a farmer moves to town (plus relief costs when unemployment rates are high), etc.

in our discussion of project evaluation.* Net income should be sufficient to allow him to reinvest in developing his unit, while price and income incentives should encourage him to do so. Overwhelming debt burdens which weigh upon his earning capacity should be avoided; proper project planning should not allow them to appear. Finally, his relationships with the project administration (in the case of directed projects) should inspire mutual confidence and respect. An overseer on a public project can be just as autocratic with his settlers as a patron is with his sharecroppers or peones on an hacienda; there is no sense preserving outmoded or oppressive social systems, especially when these systems demonstrate a low level of economic efficiency or inhibit agricultural development.

*The tax structure could possibly contribute to this objective also.